

The Incidence of "Silent" Coronary Heart Disease

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■ *In a group of clinically normal male executives subjected to maximal treadmill stress testing, the occurrence of ischemic ST segment responses was in all cases unaccompanied by pain, while in a clinically suspect group a large proportion of those having ischemic ST segment responses did not have chest pain.*

While a significant number of persons have no subjective sensation of pain while having ischemic ST segment changes on the electrocardiograph during or after maximal treadmill exercise, occasionally atypical pain may occur during or following exercise. Maximal treadmill stress testing is useful in discovering "silent" coronary artery disease.

THE INCIDENCE OF unsuspected coronary heart disease detected by exercise stress testing has been reported by various investigators^{3,8,10,13} as ranging from 0.5 percent to 29.7 percent, variations depending upon the method employed for exercise stress, the population studied and the criteria used. Lester and associates⁶ reported in a comparative study that there was a higher incidence of segmental ST depressions associated with maximal stress testing in an apparently normal group than was associated with sub-maximal stress testing. This finding is similar to the observations of Bellet and Muller² and Doan and associates.⁴

The present study was undertaken to compare the incidence of ischemic ST segment abnormality in a clinically unsuspected group and to determine, by age groups, the incidence of chest pain occurring with ST segment abnormality on maximal

treadmill stress testing. The value of such a study lies in the discovery of clinically unsuspected persons having coronary heart disease without any warning of impending complications.

Material and Method

Two hundred and eighty-four male executives who were referred for routine examinations were included in this study. The age range was from 31 to 70 years. None of the group admitted to having had chest pain or symptoms suggestive of angina pectoris. The results of physical examination, routine 12-lead electrocardiogram and chest x-ray films were normal in this group. One thousand patients in a second group referred for maximal treadmill stress testing were also studied to determine the incidence of ischemic ST segment changes without evidence of co-existing pain. Patients in this group were suspected on clinical grounds of having coronary insufficiency or had been referred by their physicians for baseline treadmill stress tests

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S-T SEGMENT CHANGE WITH EXERCISE

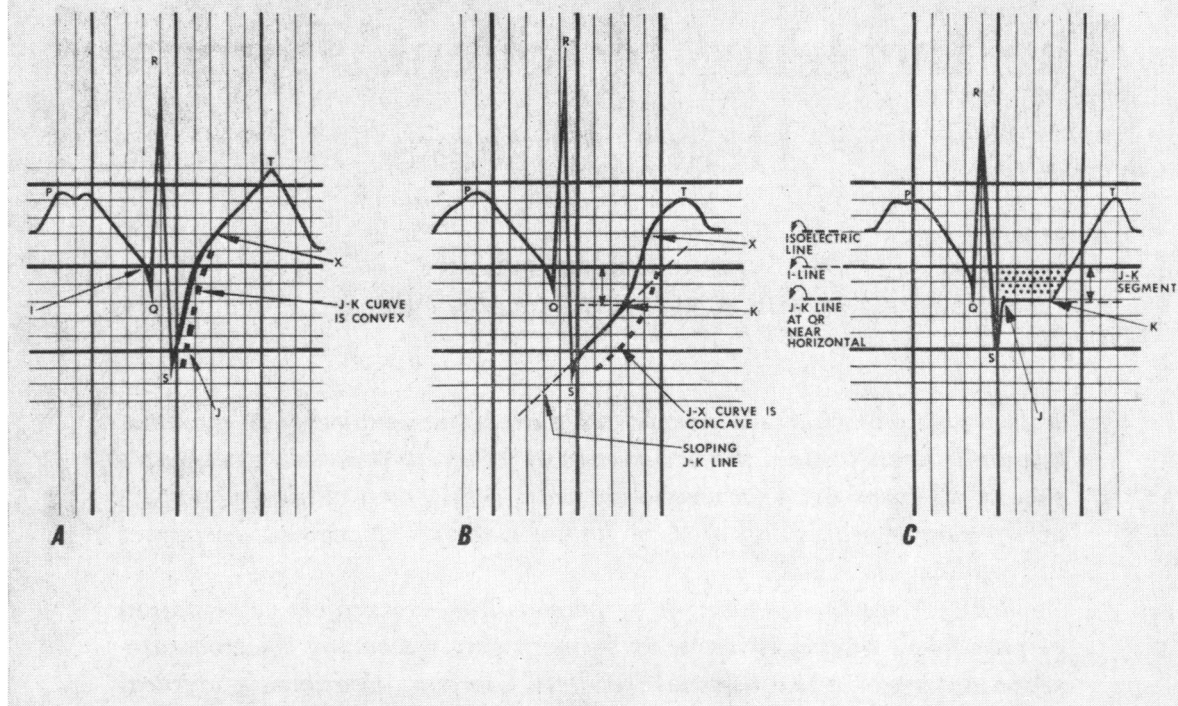


Figure 1.—A. This ECG complex demonstrates the normal J-point depression which occurs frequently following maximal exercise. B. The slow return of the ST segment to the baseline with a 2 mm or more depression of the K to isoelectric line interval is interpreted as an ischemic ECG response. Lesser degrees of depression of this interval with concavity of the j-x curve is interpreted as equivocal. C. There is depression and straightening of the ST segment of at least 2 mm for at least 0.08 seconds. This would meet our criteria for a clearly positive or ischemic ST segment response to treadmill exercise.

as part of a preoperative evaluation. There were 205 females and 795 males in this group with ages between 7 and 85 years. The patients, who were placed in the protocol in consecutive order of referral, represented a hospital laboratory population, as contrasted with the executive group who were not clinically suspected of having pathological changes. Patients receiving digitalis were instructed to discontinue this medication for two weeks before treadmill testing, since this medication is known to produce false-positive results.⁵ No attempt was made to categorize the 1,000 patients as to obesity, smoking habits or menopausal status, for we were interested only in the incidence of ischemic ST segment changes without co-existing pain.

The method used for maximal treadmill stress testing has been previously described.⁵ The baseline electrocardiogram (ECG) and the after-exercise ECG were recorded in the sitting position, while

supine ECG tracings were taken if suspicious but non-diagnostic ST depression was noted on the oscilloscopic monitor following exercise. Each patient was encouraged to complete the test; however, the exercise was terminated if the patient became exhausted, if a moderate reduction in blood pressure occurred, if multiple premature ventricular contractions or ventricular tachycardia appeared, or if progressive ST depression or progressive chest pain during exercise occurred. The patient's maximal pulse rate response to graded exercise was compared with the maximal predicted pulse rates compiled by Robinson.¹² In this way we could determine whether or not the patient had been maximally stressed, as there is a good correlation between maximal pulse rate and maximal cardiac output.^{1,7,11,14}

Ischemic ST segment changes on the electrocardiogram associated with maximal exercise stress is arbitrarily defined as a 2mm ST depression below

TABLE 1.—Data on Development of Pain in Subjects with "Ischemic" Response to Maximal Treadmill Stress Tests

Ages	Total	<u>Men</u>		Ages	Total	<u>Women</u>	
		With Pain	Without Pain			With Pain	Without Pain
31-40	15	2 (13%)	13 (87%)	31-40	3	2 (67%)	1 (33%)
41-50	74	30 (41%)	44 (59%)	41-50	16	7 (44%)	9 (56%)
51-60	74	23 (31%)	51 (69%)	51-60	12	5 (42%)	7 (58%)
61-70	29	11 (38%)	18 (62%)	61-70	12	8 (67%)	4 (33%)

the I-line persisting for at least 0.08 seconds (Figure 1). J-point depression is considered a normal finding with maximal stress. T-wave changes by themselves are not considered in the evaluation of ischemic response to exercise if there are no co-existing ST segment abnormalities.

Results

As they wished to have a satisfactory endurance report, the executives tested were motivated to perform at their maximal levels of endurance. All of the subjects performed maximal treadmill stress testing without complications and none of the subjects had to be stopped because of chest pain or electrocardiographic abnormalities as previously defined.

Of the 284 executives tested, there were 30 (11 percent) who, during or after exercise, had ischemic ST segment changes and ten (3.5 percent) who had equivocal ST segment changes. In no instance was chest pain present with ischemic ST segment abnormalities. In the 1000 subjects in the second group who were similarly tested by maximal treadmill stress, 192 of the 795 males (24 percent) and 43 of the 205 females (21 percent) had positive treadmill stress tests indicative of ischemic changes. When the incidence of chest pain associated with ischemic ST segment changes in the second group was studied in relationship to sex and age grouping (Table 1), it was apparent that in the majority of male subjects having ischemic ST segment changes, the changes occurred without a warning pain in the chest. In the female subjects, those in the 31-40 and 61-70 age groups had a higher incidence of chest pain associated with ischemic ST segment changes produced by maximal stress. Only 88 (37 percent) of the 235 patients with positive test results had chest pain. Sixty-three percent had ischemic changes without pain. The difference between these percentages was significant at less than the .01 level of probability. There was a slightly increased incidence of "painless" ischemic ST segment changes in the 41-50 and 51-60 age groups of women.

A comparison of males and females by age

group with the percentage of ischemic ST segment changes without pain disclosed a greater incidence of "painless" ischemic ST segment changes among men in the 31-40 age group (87 percent) than in women of that age (33 percent). This difference in percentage became negligible in the 41-50 year age group, with 59 percent of the men and 56 percent of the women having "painless" ischemic ST changes with stress testing. The trend was similar beyond the age of 41, although the men consistently had a greater incidence of positive treadmill stress tests without subjective evidence of pain.

Discussion

The use of a standardized treadmill maximal stress test was of value in the discovery of ischemic heart disease in 11 percent of a clinically unsuspected group of executives. It was of further interest that chest pain was not associated with the ischemic ST changes in any one of this group. Typical coronary pain in the absence of ST depression is extremely rare and we have not seen it more than two or three times. Despite the use of more stringent criteria for the establishment of ischemic ST segment abnormality than were used by Manning,⁸ Mattingly,¹⁰ or Brody,³ we were able to discover a significantly greater percentage of ischemic abnormalities with stress testing in a clinically normal group than those investigators did. It probably should be noted that the investigators mentioned did not employ maximal stress testing in their studies, but rather used the double Master test. Doan and his group⁴ found that they were able to demonstrate 1 percent positive ischemic responses out of 210 clinically normal men by the use of the double Master test, while ischemic ST changes were demonstrated in 9 percent of this same group with the use of maximal treadmill stress testing. Our findings tend to confirm Lester's⁶ and Doan's⁴ conclusions that maximal stress testing increases the diagnostic yield.

When consideration was directed to a large group of patients referred for exclusion of ischemic heart disease, it was found that out of 192 men with positive reaction to treadmill stress tests, there

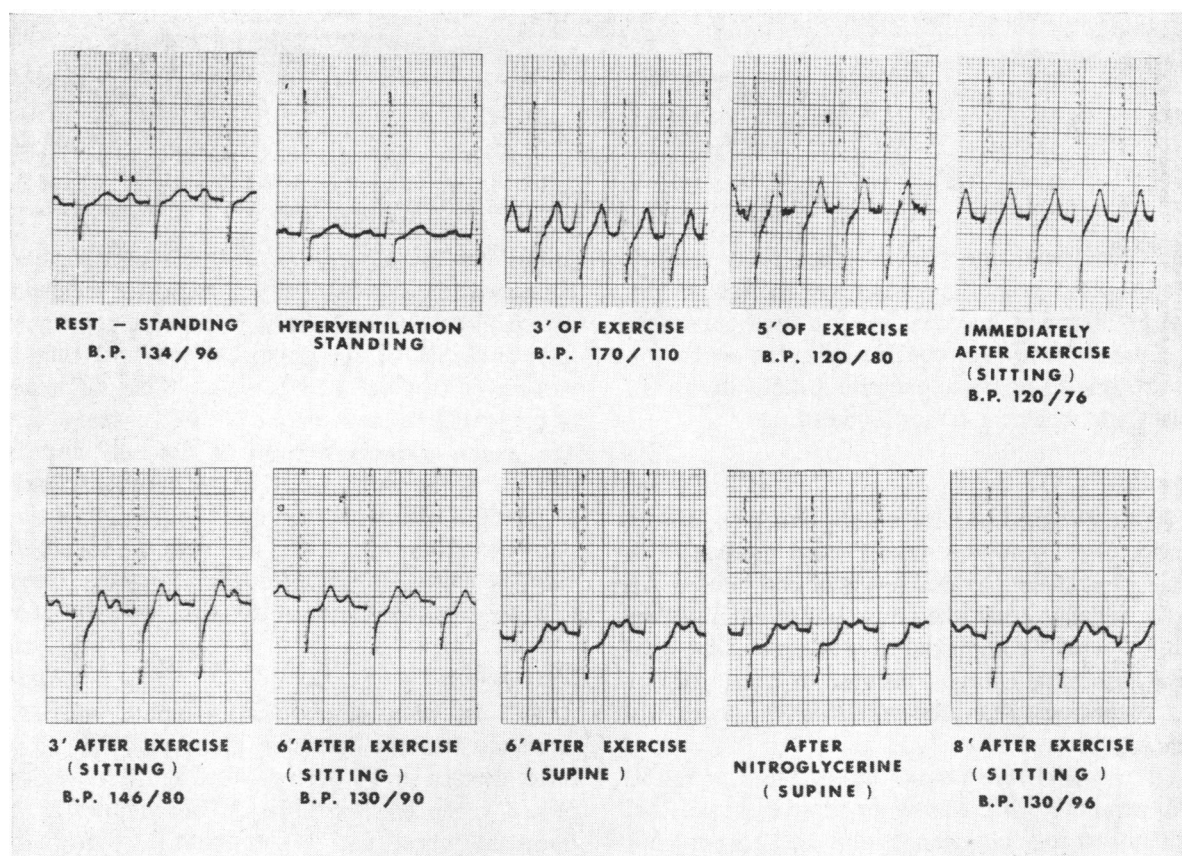


Figure 2.—A moderate rise in blood pressure was noted during the third minute of treadmill exercise at 1.7 mph. However, during the fifth minute of exercise at 3 mph the blood pressure fell to below the resting level. Ischemic ST changes did not appear until 6 minutes after exercise and further ST depression was observed while the subject was in the supine position. No significant change was noted after administration of nitroglycerine.

were 126 (66 percent) in whom the reaction occurred without chest pain. Of 43 women having positive treadmill stress test reaction, 22 had chest pain and 21 did not. In patients beyond the age of 40 there was a greater incidence of positive reaction to treadmill stress tests making a likely relationship between the subject's age and a positive response. Mason⁹ noted a similar relationship. When age groups were considered, it was demonstrated that the majority of men in all age groups having positive treadmill stress tests did not have associated pain. Women in the 31-40 year age group had a lesser incidence of positive treadmill stress tests without pain than did men, in the same age bracket. Beyond the age of 40, while the men had a greater percentage of positive stress tests without pain than did women, the relative incidence was strikingly similar, being highest in the 51-60 year age group.

As mentioned by Lester and coworkers⁶ there may be a difference in source populations to ac-

count for the different percentages of unsuspected coronary heart disease detected by exercise stress testing. Our discovery rate of 11 percent positive maximal treadmill stress tests in a clinically unsuspected group emphasizes the importance of screening various clinically normal populations in order to uncover silent coronary heart disease. Further, it is of importance to realize that the majority of men having treadmill stress test response indicating ischemia do not have concomitant chest pain. This is also true of middleaged women. This knowledge makes it imperative to instruct such patients to limit their physical activities to levels under that which produced ischemic ST segment changes on maximal stress testing, for they are not given a warning of their reduced coronary perfusion. It is a common practice to tell patients to use chest pain to signal the endpoint when exercising. This appears to be somewhat dangerous, for many patients may be stressing themselves to the point of early ventricular

failure, with dyspnea and fatigue as the only sensations recognizably related to the advanced ST depression.

Occasionally atypical chest pain during or after exercise will present a diagnostic challenge for evaluation. A 38-year-old man was able to perform treadmill exercise for 5 minutes before stopping due to dyspnea and fatigue. Chest pain did not develop during exercise, but he complained of aching in his left jaw and left arm 2 minutes after exercise. His ECG tracings (Figure 2) demonstrate no ischemic abnormalities until 6 minutes after exercise, at which time straightening and depression of the ST segments were noted. This ST segment depression was augmented by assuming a supine position which is a maneuver we have reported on earlier to enhance the yield of ischemic ST abnormality.⁷ This study was interpreted as positive for ischemic abnormality and 4 days later when the patient was being scheduled for coronary angiography, he suddenly dropped dead.

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A SCHEDULE OF ANTACIDS FOR ULCER PATIENTS

"Given an ulcer patient and given the problem of a practical therapeutic program, it seems to me that one can say, 'Okay, Mr. Smith, you take your breakfast at eight o'clock, your lunch at 12 o'clock noon, and your dinner at six o'clock. And now we know that food buffers and neutralizes for an hour or two hours, so you take your antacid at 9:30 or 10 o'clock, take another one at eleven, take other antacids at two and four o'clock in the afternoon, eight o'clock in the evening, and bedtime.' That's only six times a day, but together with the food, and then if you add an anticholinergic (preferably before meals because Chapman showed years ago that it's easier to get the effect of the anticholinergic before the stimulus of food than after), you can work out a practical program of dealing with peptic ulcer. I'm recommending this for the active ulcer patient. I do not wish to be in the position of saying this will really, absolutely prevent recurrences in 100 percent of cases, but it represents a practical approach."

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